Aviation Investigation Final Report

Location:	Manitowoc, Wisconsin	**Accident Number:**	CEN16LA296
Date & Time:	July 30, 2016, 12:30 Local	**Registration:**	N5294K
Aircraft:	Ryan NAVION B	**Aircraft Damage:**	Substantial
Defining Event:	Loss of engine power (total)	**Injuries:**	1 Minor, 1 None
Flight Conducted Under:	Part 91: General aviation - Personal		

Analysis

According to the private pilot, the engine run-up, taxi to the runway, and takeoff were normal. After establishing a positive climb rate, the pilot retracted the landing gear. Shortly after the gear retraction, the engine lost total power. The pilot quickly tried to restart the engine without success and then conducted a forced landing on the remaining runway. The airplane impacted the side of the runway and came to rest upright.

An examination of the engine revealed no anomalies. No fuel was found in the fuel lines from the firewall to the engine fuel system components. The fuel selector valve and gascolator were removed for further examination and testing. A vacuum test of the fuel selector valve revealed no anomalies. The gascolator exhibited fuel staining on the top of the casting. A vacuum test of the gascolator revealed that it leaked severely due to degraded rubber gaskets. It is likely that the leaks in the gascolator allowed air to enter the fuel system and resulted in the loss of engine power. The pilot stated that he typically needed to use the electric fuel boost pump in the low position to keep the engine running smoothly during the run-up and taxi until the engine reached normal operating temperature, which was contrary to the airplane checklist that was provided by the pilot.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

A leak in the gascolator due to degraded rubber gaskets, which allowed air to enter the fuel system and resulted in fuel starvation and a total loss of engine power during takeoff.

Findings

Aircraft	Fuel filter-strainer - Damaged/degraded
Aircraft	Fuel - Fluid level
Personnel issues	Repair - Maintenance personnel

Factual Information

History of Flight

Initial climb	Fuel starvation
Initial climb	Loss of engine power (total) (Defining event)
Initial climb	Collision with terr/obj (non-CFIT)

On July 30, 2016, at 1230 central daylight time, a Ryan Navion B single-engine airplane, N5294K, impacted the runway during a forced landing following a loss engine power during initial climb from the Manitowoc County Airport (MTW), Manitowoc, Wisconsin. The private pilot sustained minor injuries, the passenger was not injured, and the airplane sustained substantial damage to the left wing. The airplane was registered to Rapier Aviation LLC, Lewes, Delaware, and operated by a private individual as a 14 Code of Federal Regulations Part 91 personal flight. Visual meteorological conditions prevailed at the time of the accident and a flight plan was not filed. The local flight was originating at the time of the accident.

According to the pilot, prior to takeoff, the engine run-up, taxi to the runway, and takeoff were normal with no anomalies noted. After establishing a positive rate of climb, the pilot retracted the landing gear. Shortly after the gear retraction, the engine lost total power. The pilot quickly tried to restart the engine without success. The pilot performed a forced landing back to the remaining runway surface. The airplane impacted the side of the runway and came to rest upright.

Post-accident examination of the airplane by a Federal Aviation Administration (FAA) inspector showed the left wing and forward fuselage were bent. The airplane was recovered to the pilot's hangar for further examination.

On August 8, 2016, the airplane and airplane records were examined at the pilot's hangar by the National Transportation Safety Board (NTSB) investigator-in-charge, a FAA inspector, and a representative from Continental Motors, Inc (CMI). During the examination, the airplane was resting on its fuselage with the landing gear retracted. Visual examination of the engine showed the fuel system throttle body and fuel metering unit, located on the underside of the engine, were damaged due to the impact. The throttle and mixture control arms were intact and operational. The engine fuel pump was removed and manually rotated with no anomalies noted. No fuel was expelled when the pump was rotated. The fuel pump drive coupling was intact. The engine fuel pump hoses were removed and no fuel was found in the inlet and outlet hoses. The fuel manifold valve was disassembled and a small amount of fuel was present. The fuel nozzles were removed and clear of contaminants. The six engine cylinders were examined with a lighted borescope. The examination did not reveal any damage or unusual wear issues in the cylinders. The engine was manually rotated and continuity of the crankshaft and valve train components was verified. Thumb compression was achieved on all cylinders. Both magnetos produced spark at the individual ignition leads when the engine was manually rotated. During the examination, the fuel selector was observed in the off position. When the fuel selector was selected to each tank position (main, left tip, right tip), fuel drained from the airplane.

During conversations with the pilot, he stated that he started the engine using normal airframe electric fuel boost pump operation (high position to fuel flow peak) and needed to leave the fuel boost pump in the "low" position to keep the engine running after start. The pilot added that the low position was necessary to keep the engine running smoothly during taxi and engine run-up. He stated that after the engine reached normal operating temperature, the fuel boost pump could be turned off and was not required for a smooth running engine. After the accident, the airplane was recovered by local airport personnel to the pilot's hangar. Fuel was noted to be leaking from the airplane and the fuel selector was turned to the off position. The position of the fuel selector prior to being turned off was not determined. The pilot stated he only used the main tank fuel selector position for takeoff and landing phases of flight.

A review the airplane checklist provided by the pilot showed the following related to the fuel boost pump:

Starting Engine:

Fuel Pump On High to Fuel Flow Peak

Fuel Pump Off

The checklist did not indicate any other uses for the fuel boost pump for airplane operation. The source of the checklist was not determined.

On September 15, 2016, the airplane was examined at the pilot's hangar by the NTSB investigator-in-charge and a FAA inspector. An airplane recovery service was used to access the underside of the airplane to examine the fuel system components. The airframe electric fuel boost pump outlet and inlet lines were removed. No fuel was found in the pump outlet line (which connected to engine fuel pump), and fuel drained from the the boost pump inlet line when the fuel selector was moved to each tank position (main, left tip, right tip). Forced air was applied to all fuel lines within the fuel system, and the lines were clear of debris and contaminants. Fuel flowed freely from all tanks to the gascolator to the electric fuel boost pump, and to the engine fuel pump. Approximately 11 gallons of fuel was drained from the main tanks, and an unmeasured amount (more than several gallons) was drained from each tip tank.

The fuel selector and gascolator were removed and vacuum tested for leaks. The gascolator exhibited fuel staining on the top of the casting. Koehler 2201B, ASSY K22 0B was cast in the top cover of the gascolator. The fuel selector vacuum test revealed no leaks or anomalies. The gascolator vacuum test revealed air leaking from the top seal and the gascolator could not achieve a vacuum of 24" (only get to 20") and the bleed down exceeded 5" in less than one minute. The top and bottom seals were comprised of rubber gaskets which were meshed to a wire screen by a glass cylinder. When assembled, the glass cylinder was tightened between two caps which each contained the rubber gaskets and wire mesh. The gascolator was disassembled and the rubber gaskets were hard and immalleable.

On October 26, 2016, at the facilities of Continental Motors, Inc., under the supervision of a NTSB investigator, the engine fuel pump was examined and functionally tested. The fuel pump had been field overhauled as indicated by the non-CMI impression on the lead seal. The fuel pump turned freely and there were no abnormalities present. The fuel pump was flowed on a CMI test bench and functioned through its full range of operation. No adjustments were made to the fuel pump during the test. At 2,600 RPMs, the specification fuel flow (PPH) and specification fuel pressure (PSI) were 149.00 - 150.00 PPH

and 33.70 - 34.30 PSI, respectively. The observed PPH and PSI were 149.69 and 29.84, respectively. CMI noted the following for the functional test:

"Fuel System Component Flow/Pressure Test: The "Observed" fuel flows and/or pressures are recorded without adjustment (unless noted) of the fuel system component. The additional values in each table are engineering specifications for the original calibration of the component to insure desired performance within the full range of operation. These tests and adjustments are carried out in an environment of controlled fuel supply pressures and calibrated test equipment.

When engines are installed in aircraft, they are subjected to a different induction system, fuel supply system and operating environment and may require further adjustments to compensate for these differences. It is these differences that may be present in the following test bench recorded values and CMI flow/pressure specifications. These tests are conducted to confirm that the fuel system components will function adequately within its' designed limitations."

CMI's analytical report stated, "The fuel pump assembly was intact and demonstrated the ability to function normally on the test bench."

Sierra Hotel Aero, Inc. (SHA) currently holds the type certificate for the Ryan Navion. In May of 2007, SHA issued Navion Service Bulletin (SB) 106A - Fuel System - Inspection of the fuel system continued safe operation. The purpose of the SB was to require accomplishment of one time inspection of entire fuel system. This included from firewall aft for condition of all fuel lines installed including tip tanks, metal lines, fittings, hoses, vent system, vapor return, boost pump, and fuel strainer. The SB further states, inspect fuel strainer for evidence of fuel staining and leaking. Disassemble strainer and clean fuel screen. Inspect for damage and reassemble. Perform vacuum test of gascolator to include: connect hand operated vacuum pump and apply 24" of vacuum, verify bleed down does not exceed 4" over one minute, replace gaskets, fuel drain and/or gascolator as needed to ensure proper operation.

In April of 2008, the FAA issued an AD 2008-05-14 Sierra Hotel Aero, Inc. The purpose of the AD is to "detect and correct fuel system leaks or improperly operating fuel selector valves, which could result in the disruption of fuel flow to the engine. This failure could lead to engine power loss." The AD allows the owner/operator to follow the SB's issued by SHA or the field service bulletin number one issued by the American Navion Society.

A review of the aircraft records revealed the most recent annual inspection was completed on July 7, 2016, at a hobbs time of 88.9 hours, 3,033.0 total airframe hours, and 1,019.3 total engine hours. According to a major repair and alteration form (FAA Form 337), on June 19, 2009, the original fuel shut off valve was removed and replaced with a new ANS Ltd. fuel valve (part number 145-48000-ANS3) in accordance with the American Navion Society, Ltd, instructions ANS 201 as an alternate means of compliance for airworthiness directive (AD) 2008-05-14. There was no record of compliance with SB 106A.

Pilot Information

Certificate:	Private	**Age:**	44,Male
Airplane Rating(s):	Single-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Lap only
Instrument Rating(s):	None	**Second Pilot Present:**	No
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 3 Without waivers/limitations	**Last FAA Medical Exam:**	July 21, 2011
Occupational Pilot:	No	**Last Flight Review or Equivalent:**	August 15, 2015
Flight Time:	390 hours (Total, all aircraft), 13 hours (Total, this make and model), 332 hours (Pilot In Command, all aircraft), 13 hours (Last 90 days, all aircraft), 13 hours (Last 30 days, all aircraft)		

Aircraft and Owner/Operator Information

Aircraft Make:	Ryan	**Registration:**	N5294K
Model/Series:	NAVION B B	**Aircraft Category:**	Airplane
Year of Manufacture:	1950	**Amateur Built:**	
Airworthiness Certificate:	Normal	**Serial Number:**	NAV-4-2194B
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	June 7, 2016 Annual	**Certified Max Gross Wt.:**	3100 lbs
Time Since Last Inspection:	14 Hrs	**Engines:**	1 Reciprocating
Airframe Total Time:	3033 Hrs as of last inspection	**Engine Manufacturer:**	Continental Motors
ELT:	C91 installed, activated, did not aid in locating accident	**Engine Model/Series:**	IO-550-B
Registered Owner:	On file	**Rated Power:**	300 Horsepower
Operator:	On file	**Operating Certificate(s) Held:**	None

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:		**Distance from Accident Site:**	
Observation Time:		**Direction from Accident Site:**	
Lowest Cloud Condition:	Clear	**Visibility**	10 miles
Lowest Ceiling:	None	**Visibility (RVR):**	
Wind Speed/Gusts:	8 knots /	**Turbulence Type Forecast/Actual:**	/ None
Wind Direction:	90°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.06 inches Hg	**Temperature/Dew Point:**	22°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Manitowoc, WI (MTW)	**Type of Flight Plan Filed:**	None
Destination:	Manitowoc, WI (MTW)	**Type of Clearance:**	None
Departure Time:	12:30 Local	**Type of Airspace:**	Class G

Airport Information

Airport:	Manitowoc County Airport MTW	**Runway Surface Type:**	Asphalt
Airport Elevation:	650 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	7	**IFR Approach:**	None
Runway Length/Width:	3341 ft / 100 ft	**VFR Approach/Landing:**	Forced landing

Wreckage and Impact Information

Crew Injuries:	1 Minor	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	1 Minor, 1 None	**Latitude, Longitude:**	44.129722,-87.682502

Administrative Information

Investigator In Charge (IIC):	Sauer, Aaron
Additional Participating Persons:	John H Weston; Federal Aviation Administration; Milwaukee, WI Mike Council; Continental Motors, Inc.; Mobile, AL
Original Publish Date:	May 1, 2017
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=93728